zero deaths | zero serious injuries
on Montana roadways

1

Comprehensive Highway Safety Plan (CHSP)

Highway Safety Improvement Program (HSIP)

Roy Peterson – Traffic & Safety Engineer
Tricia Burke – Traffic Safety Engineer

November 2016

Roadway Facts:

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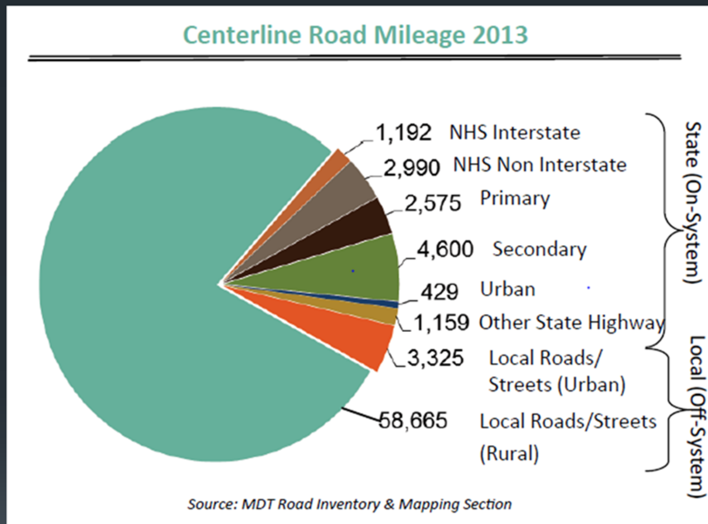
Total of 74,600 miles of roads open to public travel in Montana (centerline miles):

- Over 12,000 miles maintained by State of Montana
- 3,170 miles of urban routes (324 miles maintained by MDT)
- 5,600 miles of total roadway on the Tribal Reservations (1,124 miles maintained by MDT)

Roadway Facts:

3



- **Nearly 75,000 miles of roads open to public travel in Montana (centerline)**
- **12,000 miles maintained by State of Montana**

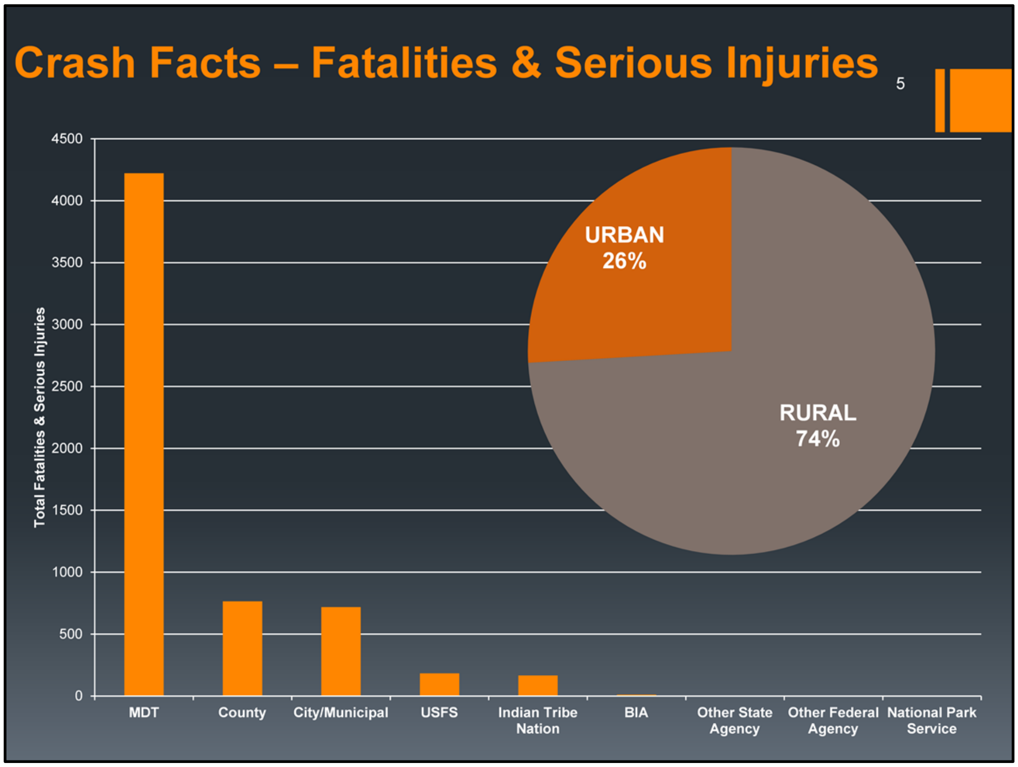
Crash Facts (2011-2015):

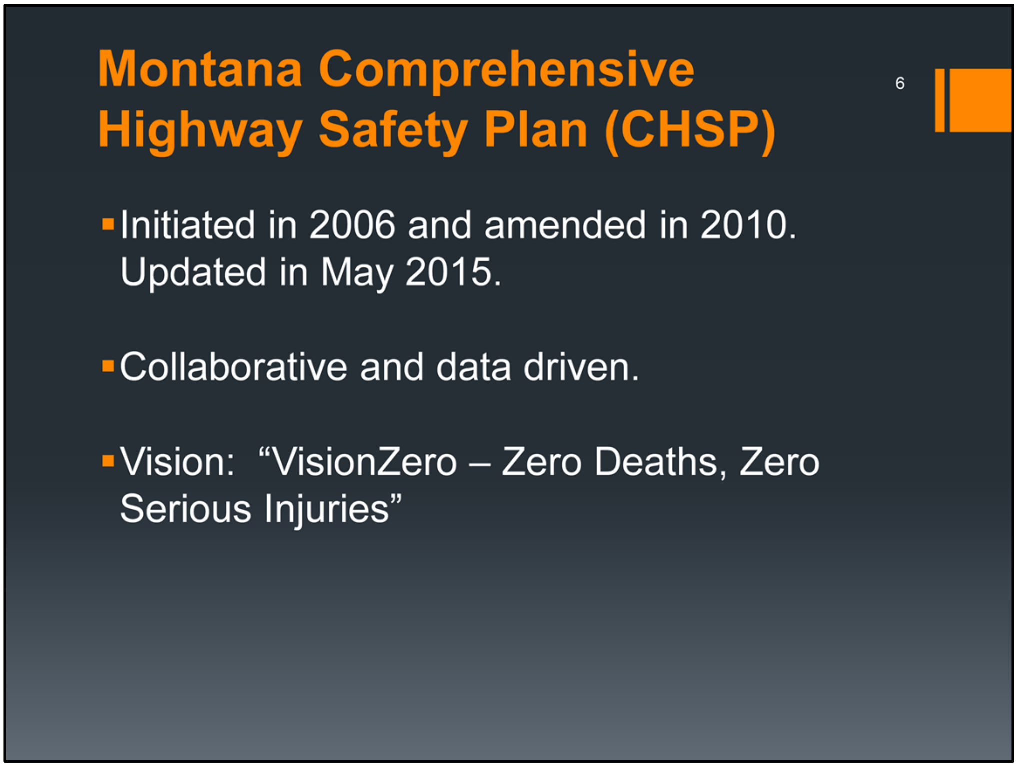
- 104,500 total crashes statewide in a 5-year period.

- **Over 6,200 fatalities and serious injuries.**

  - 2010 Census Population Figures:

    - Laurel – 6,700 people
    - Whitefish – 6,300 people
    - Blaine County – 6,491 people


Crash Facts – Fatalities & Serious Injuries
5
Total Fatalities & Serious Injuries
4500
4000
3500
3000
2500
2000
1500
1000
500
0
MDT
County
City/Municipal
USFS
Indian Tribe Nation
BIA
Other State Agency
Other Federal Agency
National Park Service
URBAN 26%
RURAL 74%



MDT took the lead in developing Montana's first Comprehensive Highway Safety Plan (CHSP). However, highway safety is not the responsibility of a single agency and the CHSP is a collaborative, data-driven approach to reducing fatalities on Montana's highways.

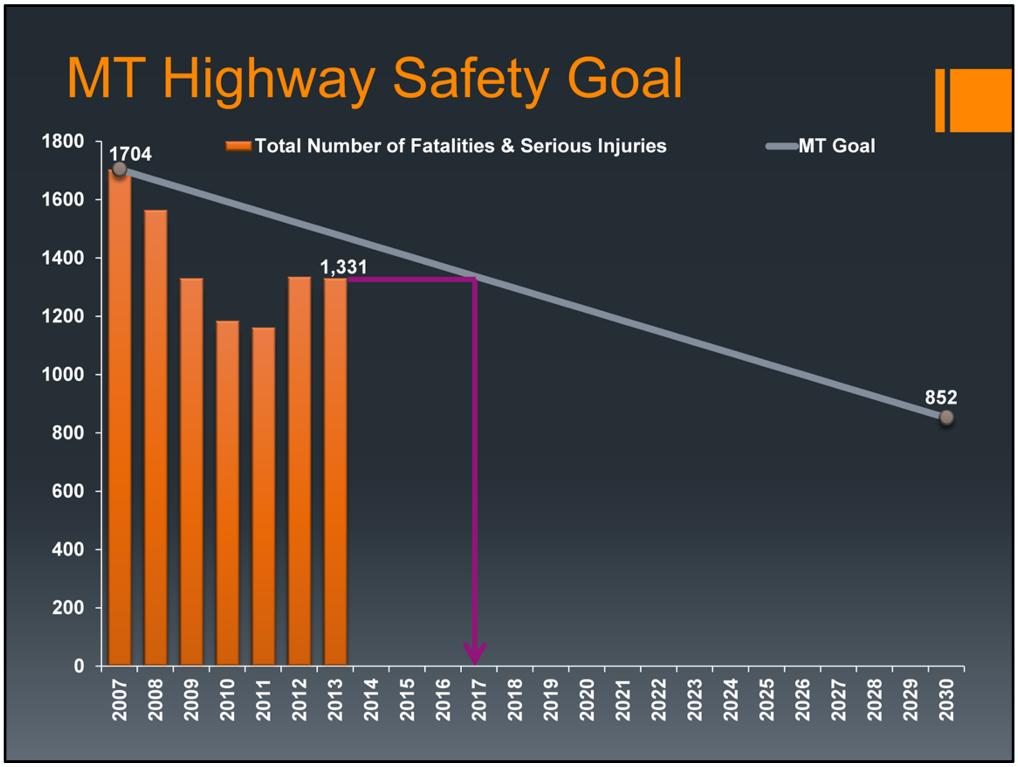
The vision used to be in the previous plan is "All highway users arrive safely at their destination". The current vision is "VisionZero – Zero Deaths, Zero Injuries"

The older plan included 12 emphasis areas that were identified by analyzing the crashes on the roads in our state:

1. Increase safety belt use to 90% 2. Reduce alcohol and drug impaired crashes
3. Reduce Native American fatal crashes 4. Reduce run off the road crashes
5. Address high crash corridors 6. Reduce number of young driver crashes
7. Reduce older driver crashes 8. Reduce large vehicle and bus crashes
9. Reduce crashes in Urban areas 10. Improve data coordination and accessibility
11. Reduce motorcycle crashes
12. Improve the delivery of emergency medical services

The current plan has been reduced to three emphasis areas: Roadway Departure/Intersections; Impaired Driving; Occupant Protection


Montana
Comprehensive Highway
Safety Plan
SLOW
TRAFFIC
AHEAD
MONTANA
BUCKLUP
MONTANA
MDT
DEPARTMENT OF TRANSPORTATION
May 2015
#VisionZeroMT
zero deaths | zero serious injuries



At the CHSP Annual Meeting in 2009, all the traffic safety stakeholders present agreed that the long-range highway safety goal for MT would be to cut the number of fatalities and serious/incapacitating injuries in half, with a baseline of 1,704 (2007 data).

The grey line is a linear depiction of how the total number of fatalities and serious injuries would need to decrease between 2007 and 2030 in order to meet our goal. The orange bars are the actual number of fatalities and serious injuries that occurred on MT highways in the last four years.

Montana CHSP Emphasis Areas

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- Roadway Departure/Intersections
- Impaired Driving
- Occupant Protection

Roadway Departure Crash Trends

- Roadway departure crashes account for about 20 percent of all people involved in crashes, but 67 percent of fatalities
- The vast majority (96 percent) of roadway departure fatalities and serious injuries occur in rural areas
- Roadway departure fatalities and severe injuries are overrepresented compared to the population among younger drivers (ages 15-34)

Intersection Crash Trends

- Intersection crashes represented 13 percent of fatalities and 24 percent of serious injuries from 2004 to 2013.
- Nearly 50% of intersection fatalities and serious injuries occur in urban areas.
- Overrepresented by drivers age; 15-34
- The most common factor of intersection crashes is driver distraction - contributes to nearly half of intersection fatalities and severe injuries.

Impaired Driving Crash Trends

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- 8 percent of people involved in all crashes but 47 percent of all fatalities and 29 percent of serious injuries.
- 2/3 of impaired driving fatalities and serious injuries involve roadway departure. More than half of impaired driving fatalities and serious injuries involve distraction, lack of occupant projection, and unlighted conditions.
- 18 percent of impaired driving fatalities and serious injuries involve persons ages 15-20, under the legal drinking age.

Occupant Protection Crash Trends

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- Unrestrained occupants are significantly overrepresented in fatal and serious injury crashes: compared to all people in crashes, they are almost 6 times more likely to suffer a fatal or serious injury when involved in a crash.
- Over half of all passenger vehicle occupants killed in a crash from 2004 through 2013 were not wearing a seat belt.
- 91 percent of unrestrained fatalities and serious injuries occur in rural areas.

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Now that we know the numbers, the data and the emphasis areas –

What is MDT's Traffic & Safety Bureau doing with this information?

Highway Safety Improvement Program (HSIP):

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- Core funding program under current highway bill (FAST Act).
- Purpose of achieving a significant reduction in fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on Tribal lands.
- HSIP projects must be consistent with the CHSP.
- HSIP funding is eligible on all public roads.

Highway Safety Improvement Program (HSIP):

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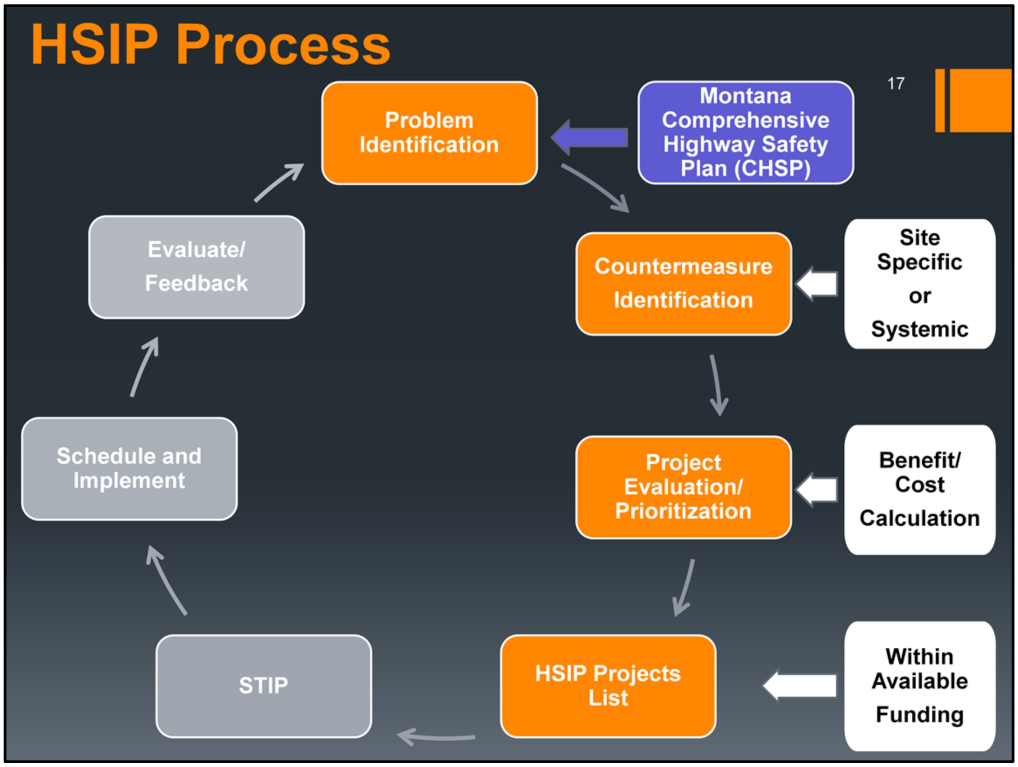
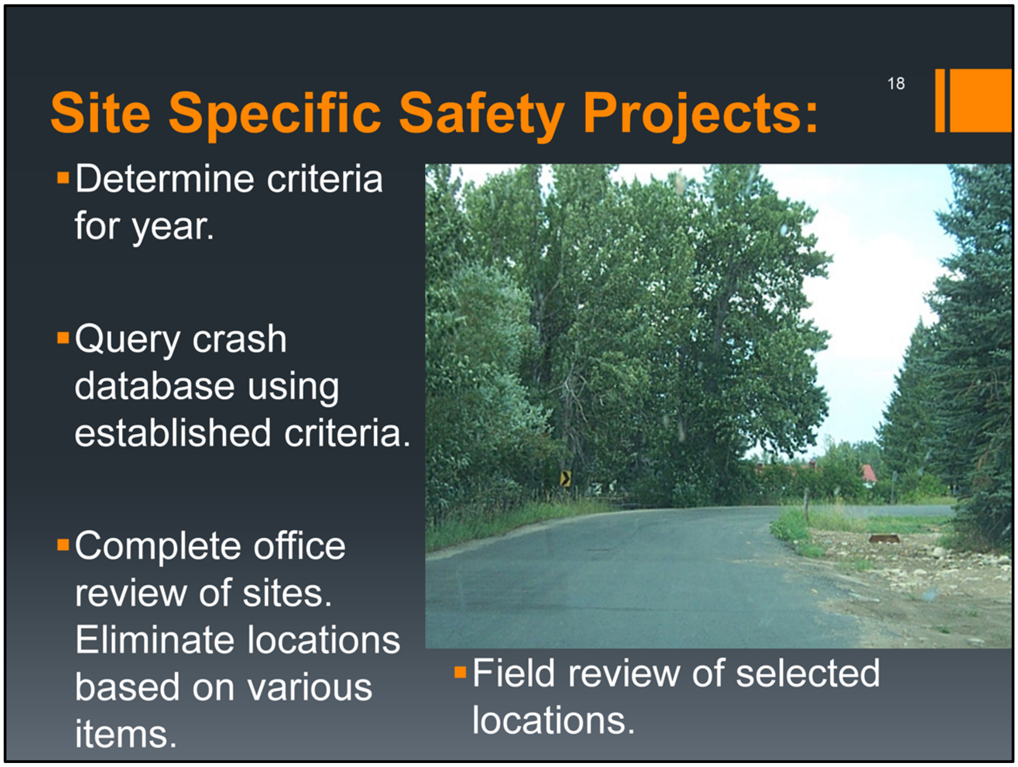
- Montana receives $25 M (+/-) annually.
  - 100% Federal Funds (most projects are eligible for 100%; some are 90%/10% split

- Data Driven – Projects identified based on crash experience, crash potential, crash rate, or other data-supported means.
  - Site specific safety projects.

  - Systemic implementation of proven counter-measures thru projects and design guidance.


HSIP Process
17
Problem Identification
Montana Comprehensive Highway Safety Plan (CHSP)
Countermeasure Identification
Site Specific or Systemic
Evaluate/ Feedback
Project Evaluation/ Prioritization
Benefit/ Cost Calculation
Schedule and Implement
STIP
HSIP Projects List
Within Available Funding



In 2012, criteria selected for the HSIP included severity index, severity rate, severe injury crashes, rural intersection related crashes, commercial vehicle crashes, and requests from outside agencies.

Field reviews are looking for locations with an identified engineering improvement to address a crash trend.

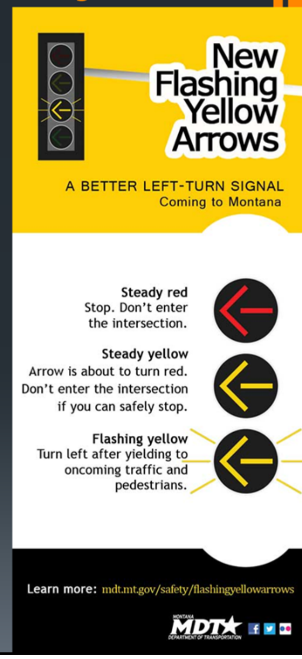
Site Specific Safety Projects:

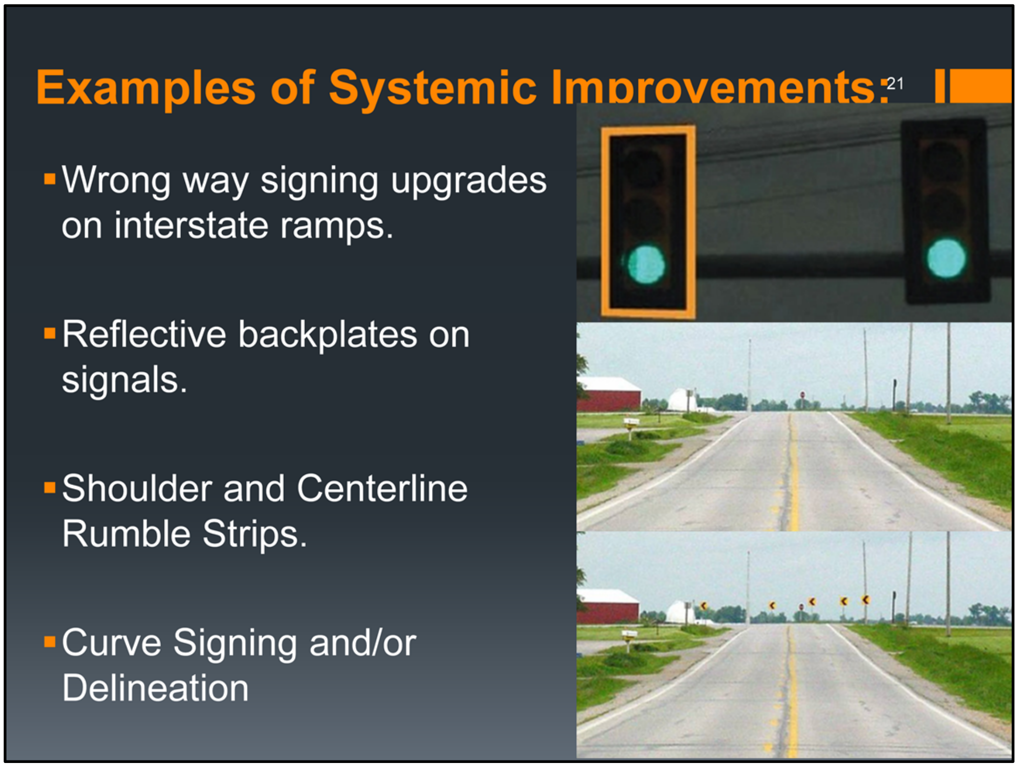
- Complete cost estimates and benefit/cost calculations for identified engineering improvement.
- Rank proposed locations based on benefit/cost.
- Move forward with projects with highest benefit/cost within funding constraints.

B = ANNUALIZED REDUCTION IN ACCIDENT COSTS
C = ANNUALIZED CONSTRUCTION COSTS PLUS INCREASED MAINTENANCE COSTS

Examples of Site Specific Projects:

- Roundabouts.
- Improvements to highway curve –slope flattening/increase radius/signing/delineation, etc.
- Installation of Flashing Yellow Arrows.
- Guardrail and/or Slope Flattening





Potential to complete systemic improvements on local roads, including delineation and signing.

Program is data driven. Locations submitted for consideration will have to compete with other locations throughout the state.

Safety Data/Analysis Tools

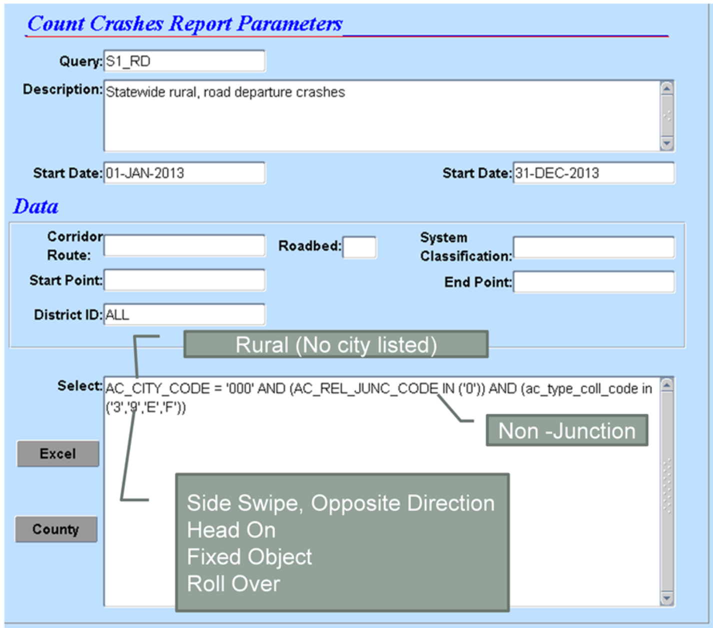
- Safety Information Management System
- Roadway Departure Study
- Intersection Safety Study

Safety Information Management System (SIMS)

Summary of New System

- **Why the change in systems?**
  - New MHP data collection system (Smartcop) - 2008.
    - Not compatible with the historic Montana Accident Reporting System (MARS) and Oracle System.
- **Next Steps**
  - COTS Product – Safety Information Management System (SIMS)
- **What is SIMS?**
  - New database and data store.
  - New front end, easy to use user interface.
  - New daily automated interface into the DOJ crash database.

SMS: Query for Road Departure Crashes



SMS: Query for Road Departure Crashes

5-NOV-2014

MONTANA DEPARTMENT OF TRANSPORTATION

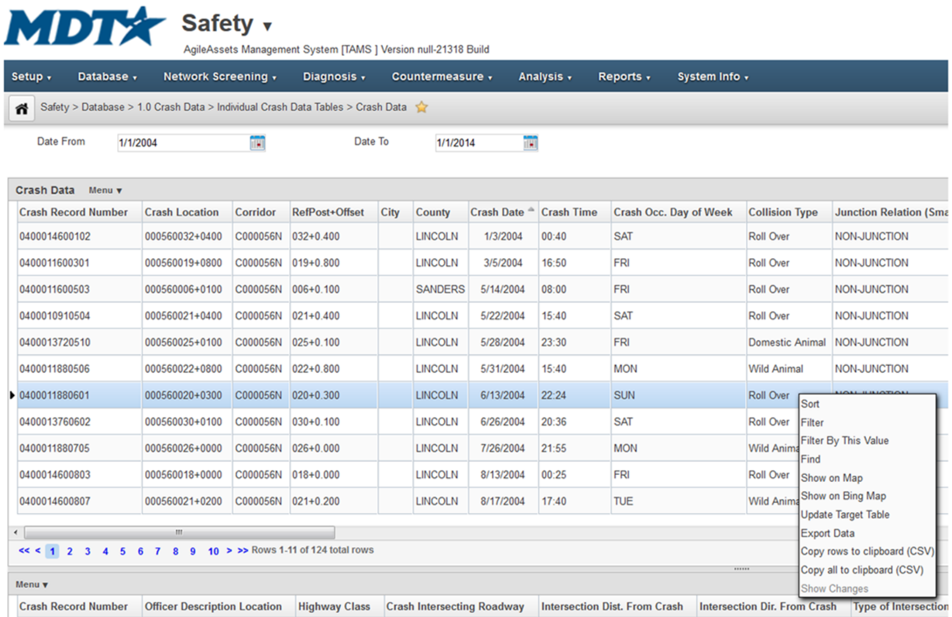
DETAILED CRASH LIST

Start Date 01-JAN-2013 End Date 31-DEC-2013 Select AC_CITY_CODE - '000' AND (AC_REL_JUNC_CODE IN ('0')) AND (ac_type_coll_

***** CRASH LOCATION & ANALYSIS *****

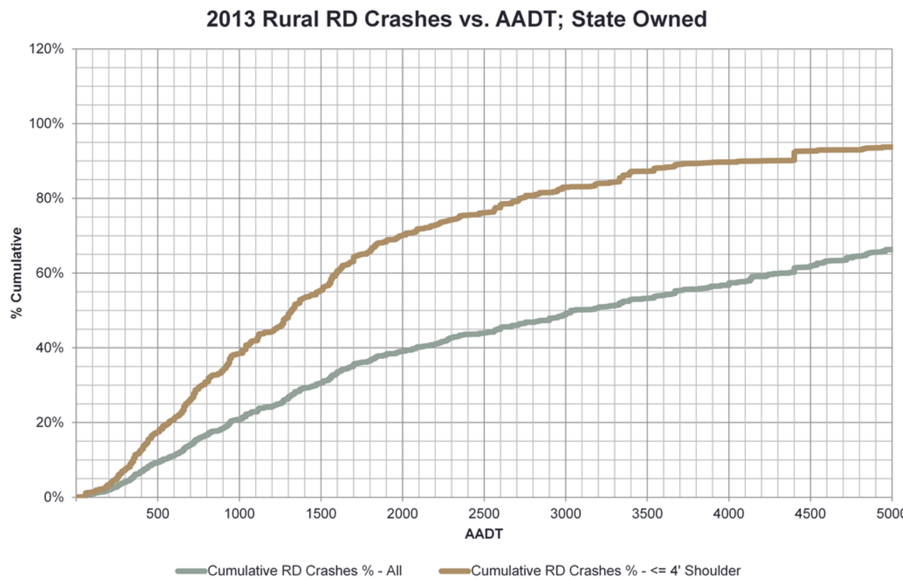
SEQ NO.	LOCATION	CRASH NO	TIME	DATE	DAY OF WEEK	JUNCT REL	ROADWAY RELATED	ENG STUDY	GRADE AND HORIZONTAL ALGN
1	00000000000000	#13C5050020824	21:00	24-AUG-2013	SAT	NJ		NONE	
2	00000000000000	#13C5050020825	21:40	24-AUG-2013	SAT	NJ		NONE	
3	00R00001E05S36	#50057893	00:05	22-DEC-2013	SUN	NJ	ROADWAY		CURVE GRADE
4	00R00001E07N03	#50049705	00:30	21-JUN-2013	FRI	NJ	OFF ROAD		STRAIGHT GRADE
5	00R00001E07N11	#50056858	17:50	10-DEC-2013	TUE	NJ	OFF ROAD		STRAIGHT LEVEL
6	00R00001E07N27	#50052569	18:50	22-JUL-2013	MON	NJ	ROADWAY		CURVE GRADE
7	00R00001E08N26	#50052606	16:40	13-JUL-2013	SAT	NJ	OFF ROAD		STRAIGHT LEVEL
8	00R00001E08N27	#50049689	01:00	16-MAR-2013	SAT	NJ	ROADWAY		STRAIGHT LEVEL
9	00R00001E08S22	#50052361	12:30	05-JUL-2013	FRI	NJ	SHOULDER LT		STRAIGHT LEVEL
10	00R00001E09N32	#50052326	13:10	08-JUL-2013	MON	NJ	SHOULDER LT		CURVE GRADE
11	00R00001E10N03	#50054210	16:00	23-OCT-2013	WED	NJ	SHOULDER		CURVE GRADE
12	00R00001E18N32	#50049080	00:00	20-MAY-2013	MON	NJ	SHOULDER RT		STRAIGHT LEVEL
13	00R00001E19N35	#50053314	08:43	16-DEC-2013	MON	NJ	SHOULDER LT		CURVE GRADE
14	00R00001E21N24	#50049085	00:00	06-JUL-2013	SAT	NJ	OFF ROAD		STRAIGHT LEVEL
15	00R00001E21N24	#50052838	12:00	15-OCT-2013	TUE	NJ	OFF ROAD		STRAIGHT LEVEL
16	00R00001E22N21	#50049993	02:22	02-MAY-2013	THU	NJ	SHOULDER LT		CURVE GRADE
17	00R00001E25N11	#50047334	22:15	06-MAY-2013	MON	NJ	SHOULDER RT		CURVE LEVEL
18	00R00001W01N22	#50050095	18:40	06-JUL-2013	SAT	NJ	SHOULDER RT		CURVE LEVEL
19	00R00001W01N22	#50053797	21:30	14-JUL-2013	SUN	NJ	SHOULDER LT		CURVE LEVEL
20	00R00001W04S30	#50057888	16:10	17-NOV-2013	SUN	NJ	SHOULDER		STRAIGHT LEVEL
21	00R00001W06N30	#50056846	14:00	06-NOV-2013	WED	NJ	OFF ROAD		STRAIGHT GRADE
22	00R00001W06S08	#50047428	07:30	27-JAN-2013	SUN	NJ	SHOULDER LT		CURVE GRADE
23	00R00001W09N22	#50046779	07:25	08-APR-2013	MON	NJ	SHOULDER RT		CURVE GRADE
24	00R00001W09N25	#50052170	18:30	28-APR-2013	SUN	NJ	SHOULDER		STRAIGHT GRADE

SIMS: Query for Road Departure Crashes

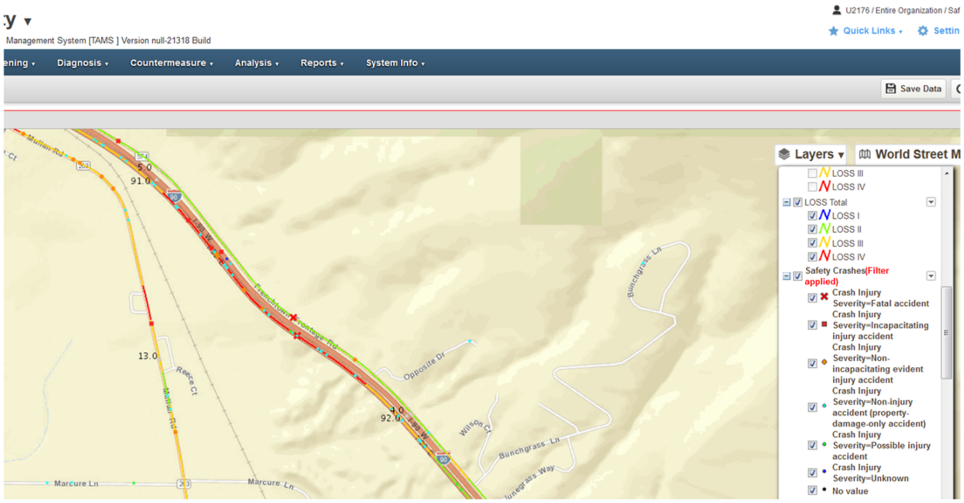


Crash Record Number	Crash Location	Corridor	RefPost+Offset	City	County	Crash Date	Crash Time	Crash Occ. Day of Week	Collision Type	Junction Relation (Sma
0400014600102	000560032+0400	C000056N	032+0.400		LINCOLN	1/3/2004	00:40	SAT	Roll Over	NON-JUNCTION
0400011600301	000560019+0800	C000056N	019+0.800		LINCOLN	3/5/2004	16:50	FRI	Roll Over	NON-JUNCTION
0400011600503	000560006+0100	C000056N	006+0.100		SANDERS	5/14/2004	08:00	FRI	Roll Over	NON-JUNCTION
0400010910504	000560021+0400	C000056N	021+0.400		LINCOLN	5/22/2004	15:40	SAT	Roll Over	NON-JUNCTION
0400013720510	000560025+0100	C000056N	025+0.100		LINCOLN	5/28/2004	23:30	FRI	Domestic Animal	NON-JUNCTION
0400011880506	000560022+0800	C000056N	022+0.800		LINCOLN	5/31/2004	15:40	MON	Wild Animal	NON-JUNCTION
0400011880601	000560020+0300	C000056N	020+0.300		LINCOLN	6/13/2004	22:24	SUN	Roll Over	
0400013760602	000560030+0100	C000056N	030+0.100		LINCOLN	6/26/2004	20:36	SAT	Roll Over	
0400011880705	000560026+0000	C000056N	026+0.000		LINCOLN	7/26/2004	21:55	MON	Wild Anima	
0400014600803	000560018+0000	C000056N	018+0.000		LINCOLN	8/13/2004	00:25	FRI	Roll Over	
0400014600807	000560021+0200	C000056N	021+0.200		LINCOLN	8/17/2004	17:40	TUE	Wild Anima	

SIMS: Crash Data + Roadway Data



SIMS: Mapping of Crashes



SIMS Tracking of Safety Projects

MDT SIMS - PROD

Safety ▾

AgileAssets Management System [TAMS] Version SAFETY_MDT 7.0.3.0-RELEASE app. 1512031643-1512031643 Build

Database ▾ Network Screening ▾ Diagnosis ▾ Countermeasure ▾ Analysis ▾ Reports ▾ System Info ▾

Safety > Analysis > Safety Projects > Step 3:Programmed Projects

Programmed Projects Menu ▾

Update Project Cost (from Phases)

Project ID	Project Number	Project Name	* State Project Number	Financial District	Project Status	Project Costs from Phases	Est. Benefit (EUAB)	Est. Benefit/Cost
147	SF 149 S OF STEVENSVLL SFTY IMP	14_C000269E_012+0.000	UPN 8914	Missoula	Programmed	$6,555,354.00	$1,773,469.31	3.55
140	SF 149 S OF HOT SPRINGS SLP FLTN	14_C000382N_013+0.300	UPN 8915	Missoula	Programmed	$464,226.00	$169,058.45	5.18
145	SF 149 FOYS LAKE SIGNING	14_C000503E_003+0.680	UPN 8916	Missoula	Programmed	$9,196.00	$343,786.81	383.91
66	SF 149 CORVALLIS SFTY IMPRV	14_C000373E_001+0.975	UPN 8929	Missoula	Programmed	$32,795.00	$43,649.28	5
163	SF 149 - KING INTCH SFTY IMPRV	14_C000090E_445+0.700	UPN 8941	Billings	Programmed	$14,393.00	$13,456.32	5.29
162	SF 149 - COLUMBUS SFTY IMPRV	14_C000421E_003+0.200	UPN 8942	Billings	Programmed	$17,041.00	$14,279.05	4.82
224	SF 159 FRENCHTOWN MEDIAN RAIL	15_C000090_084+0.200	UPN 9128	Missoula	Programmed		$1,136,084.67	8.19

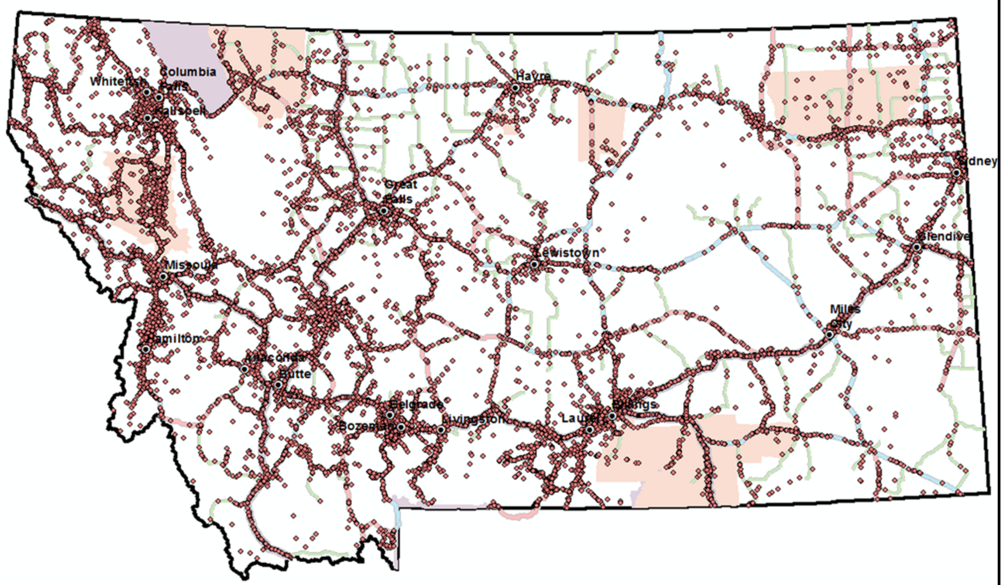
Road Departure Study

2005-2014 RD Crash Data

- 211,800 total crashes statewide in a 10-year period
  - 11,350 fatal and serious injury crashes
- Over 70% of the fatal and serious injury crashes in rural areas (8,000 crashes)
  - RD crashes are 74% of fatal and serious injury crashes in rural areas (5,900)
- Rural RD crashes as compared to all statewide crashes:
  - 23% of total crashes
  - 62% of fatal crashes
  - 52% of fatal and serious injury crashes

2014 Data is preliminary.

2005-2014 Rural RD Fatal & Injury Crashes



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How To Measure Safety?

Crash Rate is the Most Common Measure of Safety

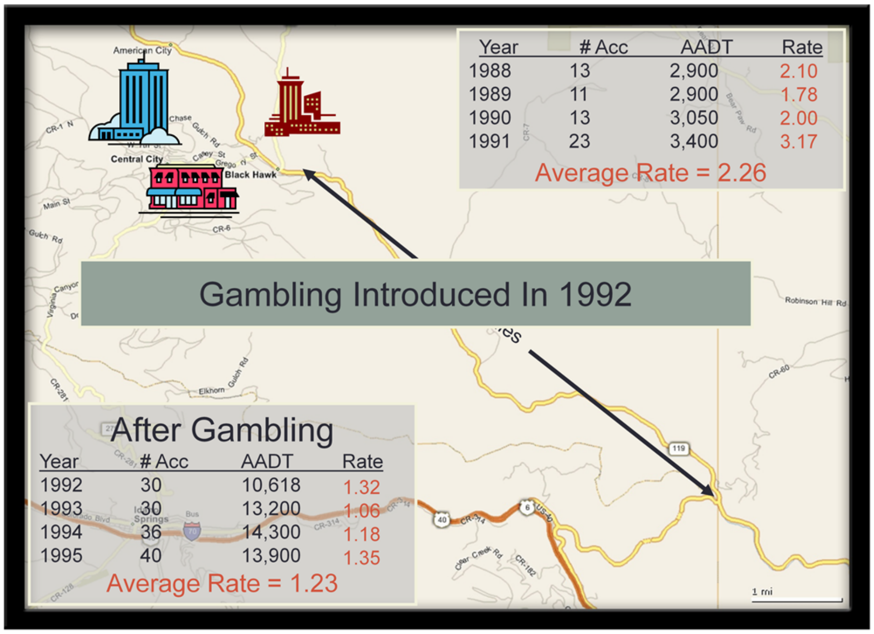
Some of the data presented is from Colorado.

Crash rate = Number of crashes per million vehicle miles.

How To Measure Safety?

$$\text{Rate} = \frac{\#\text{Crashes} \times 1{,}000{,}000}{\text{AADT} \times 365 \times \text{Length}}$$

Let's examine this application….



Year	# Acc	AADT	Rate
1988	13	2,900	2.10
1989	11	2,900	1.78
1990	13	3,050	2.00
1991	23	3,400	3.17

Average Rate = 2.26

Gambling Introduced In 1992

After Gambling

Year	# Acc	AADT	Rate
1992	30	10,618	1.32
1993	30	13,200	1.06
1994	36	14,300	1.18
1995	40	13,900	1.35

Average Rate = 1.23

- Before Gambling: Average Rate = 2.26
- After Gambling: Average Rate = 1.23
- Highway Alignment and Typical Cross-Section have not Changed
- After the Introduction of Gambling, the % of Crashes Involving Alcohol increased 500%.

How To Measure Safety?

- So the question is:
  - **Is drinking and driving combined with gambling good for highway safety?**
- Probably not; but if crash rates are used as measuring device, one could conclude that it is.

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Introducing –
The Safety Performance Function (SPF)

- In order to understand how the crash rate is changing, a relationship between safety and traffic exposure is needed.
- This relationship is reflected by a safety performance function (SPF).
- The SPF models provide an estimate of the normal or expected crash frequency and severity for a range of AADT among similar facilities.

The assessment of the magnitude of safety problems on highway segments has been refined through the use of Safety Performance Functions (SPF). The SPF reflects the relationship between traffic exposure measured in Average Annual Daily Traffic (AADT), and crash count for a unit of road section measured in crashes per mile per year. The SPF models provide an estimate of the normal or expected crash frequency and severity for a range of AADT among similar facilities.

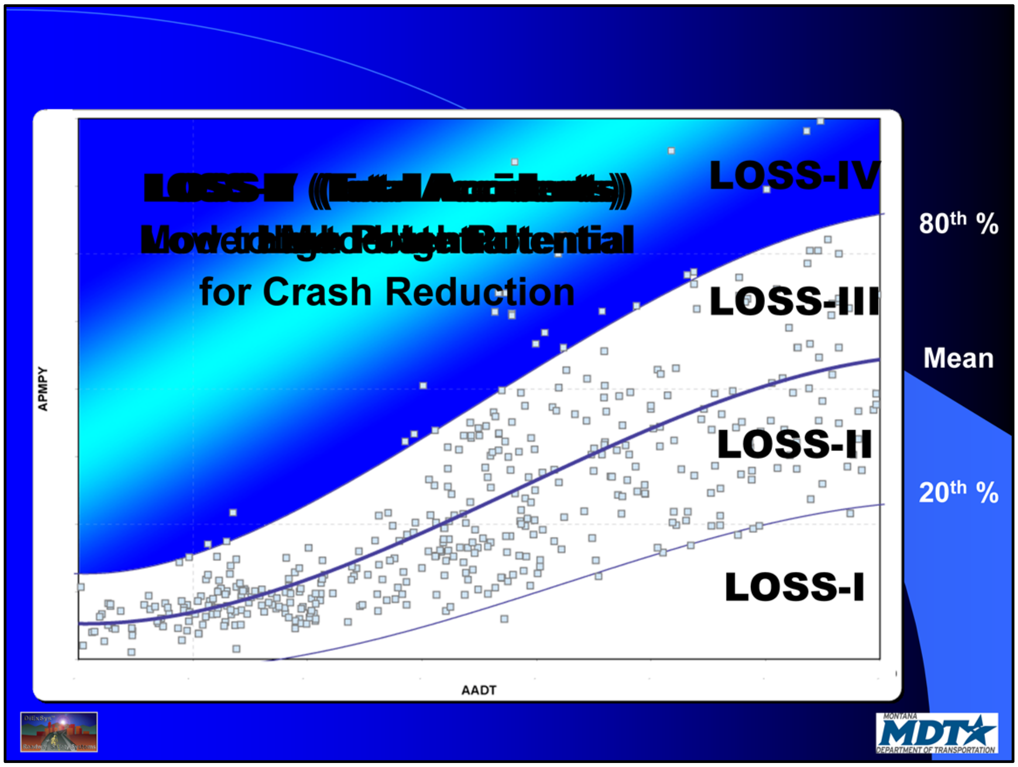
From SPF's to –
Level of Service of Safety (LOSS)
Why is it needed?

- Qualitatively and quantitatively describe the degree of safety of a roadway segment
- Communicate the Magnitude of Safety Problem of a Roadway Segment or Intersection to Other Professionals, Elected Officials, Law Enforcement, the Press, or the Traveling Public
- Bring perception of roadway safety in line with reality of safety performance reflecting a specific facility

From SPF's to – Level of Service of Safety (LOSS)

Why is it needed?

- Provide a Frame of Reference for Decision Making on Non-Safety Motivated Projects (Resurfacing or Reconstruction)
- Provide a Frame of Reference from a Safety Perspective for Planning Corridor Improvements


for Crash Reduction
LOSS-IV
LOSS-III
LOSS-II
LOSS-I
80th %
Mean
20th %
APMPY
AADT

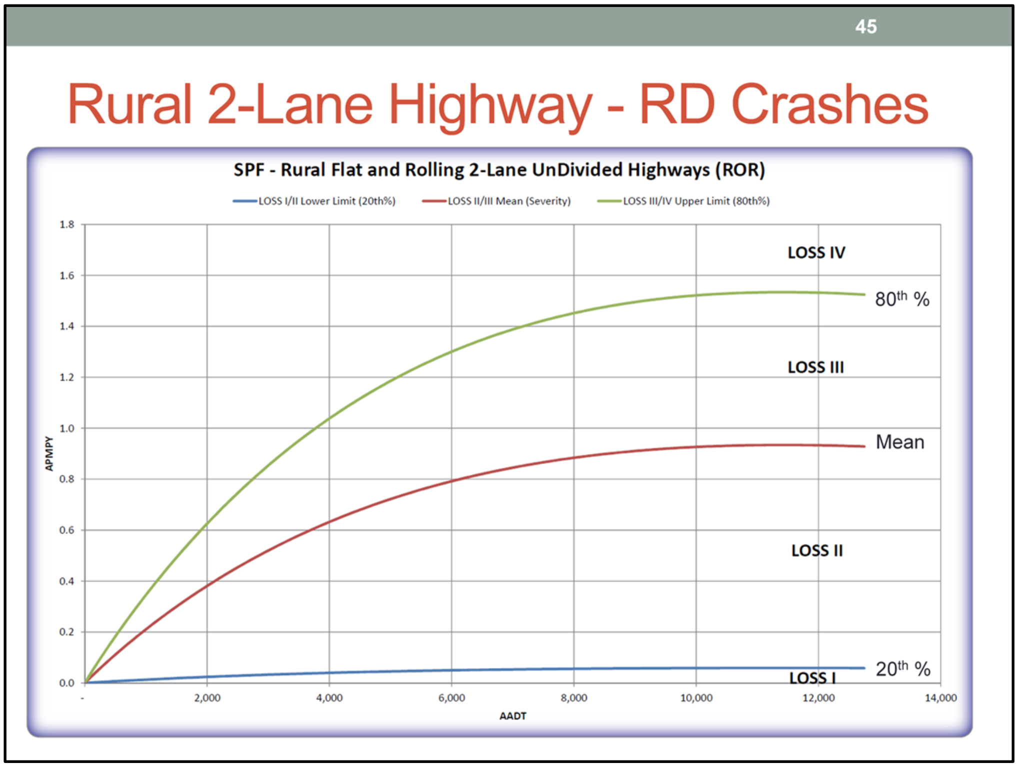
Montana Specific Roadway Segment Models

Montana-Specific Predictive and Diagnostic Tools

SPFs, Level of Service of Safety (LOSS) Boundaries and Diagnostic Menus were
developed for the following facilities:

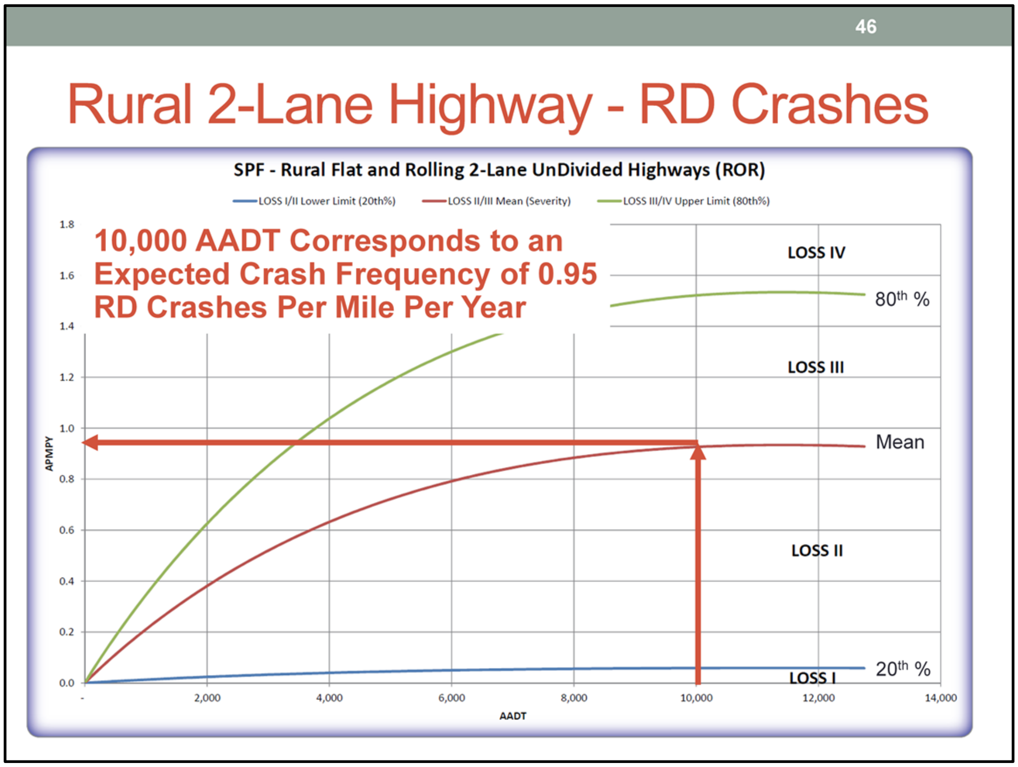
- Rural Flat and Rolling 2-Lane Highways
- Rural Flat and Rolling 4-Lane Highways
- Rural Flat and Rolling 4-Lane Freeways
- Rural Mountainous 2-Lane Highways
- Rural Mountainous 4-Lane Freeways
- Urban 4-Lane Freeways

- Roadway Departure Crashes - Safety Performance Functions for RD only crashes were also developed for:
  - 2-Lane Rural Flat and Rolling Highways (ROR)
  - 4-Lane Rural Flat and Rolling Divided Freeways (ROR)
  - 2-Lane Mountainous Highways (ROR)



Four models have been developed for on-system route types with sufficient mileage (all crashes used in the models are non-junction related):

- Total Crashes
- Total Fatal and Injury Crashes
- Road Departure Crashes (Head On, SSOD, Fixed Object, Rollover)
- Road Departure Fatal and Injury Crashes



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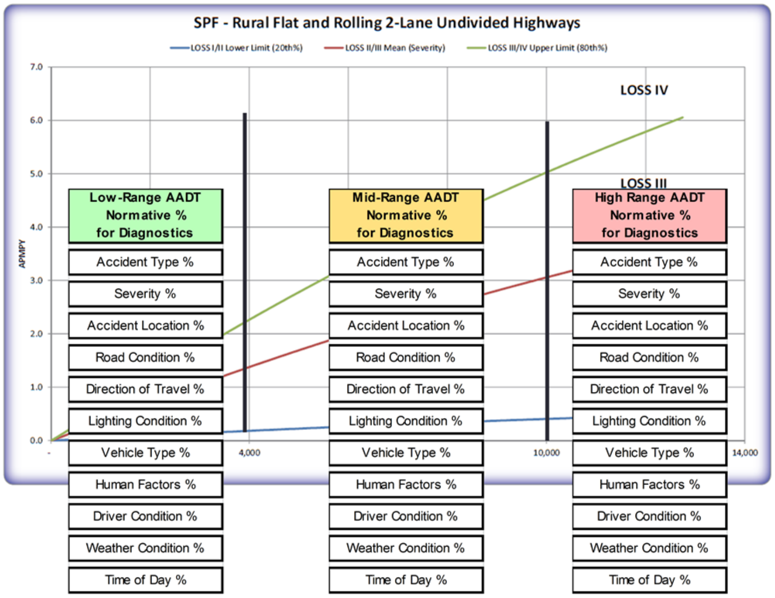
- Total Crashes
- Total Fatal and Injury Crashes
- Road Departure Crashes (Head On, SSOD, Fixed Object, Rollover)
- Road Departure Fatal and Injury Crashes

Diagnostic Norms - Crash Patterns



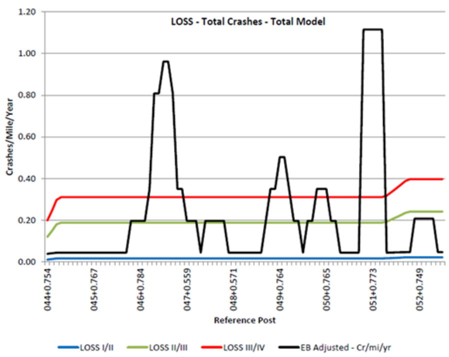
Diagnostic Norms - Crash Patterns

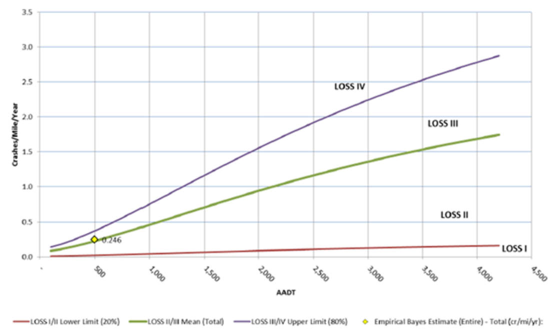
Montana Rural Flat and Rolling 2-Lane Undivided Highways								
	0 - 3000 ADT		3000 - 8000 ADT		> 8000 ADT		All Totals	
Description	Accidents	Percent	Accidents	Percent	Accidents	Percent	Accidents	Percent
Severity								
PDO	6,951	66.96%	2,320	73.14%	470	76.42%	9,741	68.75%
INJ	3,157	30.41%	798	25.16%	140	22.76%	4,095	28.90%
FAT	273	2.63%	54	1.70%	5	0.81%	332	2.34%
Persons Injured	4,585	N/A	1,124	N/A	214	N/A	5,923	N/A
Persons Killed	307	N/A	62	N/A	6	N/A	375	N/A
Number of Vehicles								
Single Vehicle Accidents	9,079	87.46%	2,487	78.40%	388	63.09%	11,954	84.37%
Two Vehicle Accidents	1,217	11.72%	622	19.61%	194	31.54%	2,033	14.35%
Three or more Vehicle Accident	85	0.82%	63	1.99%	33	5.37%	181	1.28%
Unknown Number of Vehicles	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Location								
On Road	5,524	53.21%	1,947	61.38%	427	69.43%	7,898	55.75%
Off Road	3,041	29.29%	671	21.15%	82	13.33%	3,794	26.78%
Off Road Left	1,275	12.28%	242	7.63%	31	5.04%	1,548	10.93%
Off Road Right	1,766	17.01%	429	13.52%	51	8.29%	2,246	15.85%
Off Road at Tee	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Off Road in Median	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Unknown Road Location	1,816	17.49%	554	17.47%	106	17.24%	2,476	17.48%
Accident Type								
Overturning	2,968	28.59%	490	15.45%	53	8.62%	3,511	24.78%
Other Non Collision	337	3.25%	98	3.09%	8	1.30%	443	3.13%
School Age Pedestrians	0	0.00%	0	0.00%	0	0.00%	0	0.00%
All Other Pedestrians	18	0.17%	9	0.28%	0	0.00%	27	0.19%
Broadside	152	1.46%	82	2.59%	21	3.41%	255	1.80%
Head On	135	1.30%	71	2.24%	15	2.44%	221	1.56%
Rear End	396	3.81%	281	8.86%	135	21.95%	812	5.73%
Sideswipe (Same Direction)	191	1.84%	53	1.67%	14	2.28%	258	1.82%
Sideswipe (Opposite Direction)	241	2.32%	95	2.99%	20	3.25%	356	2.51%
Approach Turn	7	0.07%	7	0.22%	4	0.65%	18	0.13%
Overtaking Turn	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Parked Motor Vehicle	29	0.28%	12	0.38%	2	0.33%	43	0.30%
Railway Vehicle	4	0.04%	1	0.03%	0	0.00%	5	0.04%
Bicycle	2	0.02%	1	0.03%	0	0.00%	3	0.02%
Motorized Bicycle	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Domestic Animal	468	4.51%	55	1.73%	5	0.81%	528	3.73%
Wild Animal	2,653	25.56%	1,127	35.53%	229	37.24%	4,009	28.30%

On-Going Uses

- Used in the SIMS for development of the Annual HSIP List.
- 2015 List Criteria:
  - Road Departure Severity Model (Fatal and Injury Crashes);
  - LOSS IV (high potential for crash reduction);
  - Minimum of 5 crashes
- 2016 HSIP List:
  - Used during diagnostic review / office review

On-Going Uses – Safety Reviews





Rural, Mountainous 2-Lane Undivided Highway					
Diagnostic Norms for Non-Intersection Related Crashes:					
Segment Number	Beginning RP	Ending RP	Description	Actual # Crashes	Cumulative Probability
Entire Project	45.000	53.730	Injury	19	100.000%
Entire Project	45.000	53.730	Off Road Left	8	99.638%
Entire Project	45.000	53.730	Overturning	12	99.224%
Entire Project	45.000	53.730	Daylight	19	99.684%
Entire Project	45.000	53.730	No Adverse Weather	22	100.000%
Entire Project	45.000	53.730	Dry Road	22	100.000%
Segment 1	45.000	48.000	Injury	7	99.954%
Segment 1	45.000	48.000	Overturning	5	98.436%
Segment 1	45.000	48.000	Daylight	8	100.000%
Segment 1	45.000	48.000	No Adverse Weather	8	100.000%

Intersection Safety Study

Intersection Safety Study

- Intersection Safety Study uses the same concepts as the Roadway Departure Study
  - Same Level of Service of Safety (LOSS) concept
    - ✓Considering the magnitude of the safety issue
  - Montana specific SPF Models for various intersections
  - Utilizes the diagnostic norms
    - ✓Analyzing the nature of the safety issue
  - One major difference is the side street volumes need to be factored into the equations

Intersection Safety Study

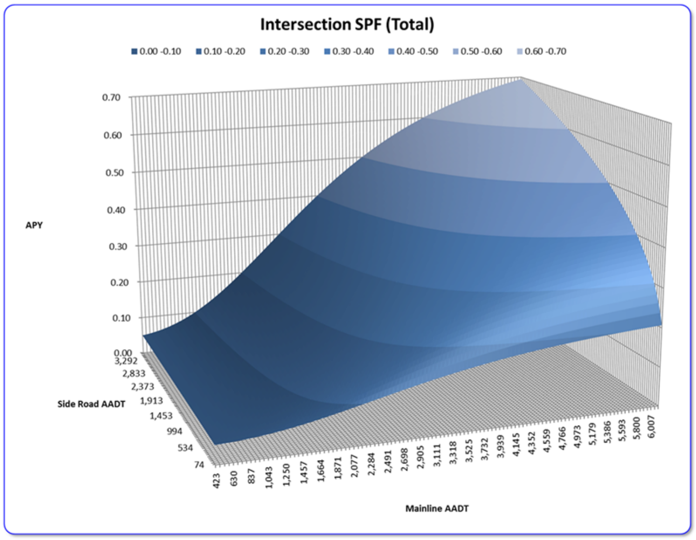
The Safety Performance Function of an Intersection can be viewed Mathematically as a 3-Dimensional Response Surface, where:

 # Crashes/Year = $f\,(ADT_{Mainline}, ADT_{Side\ Road})$

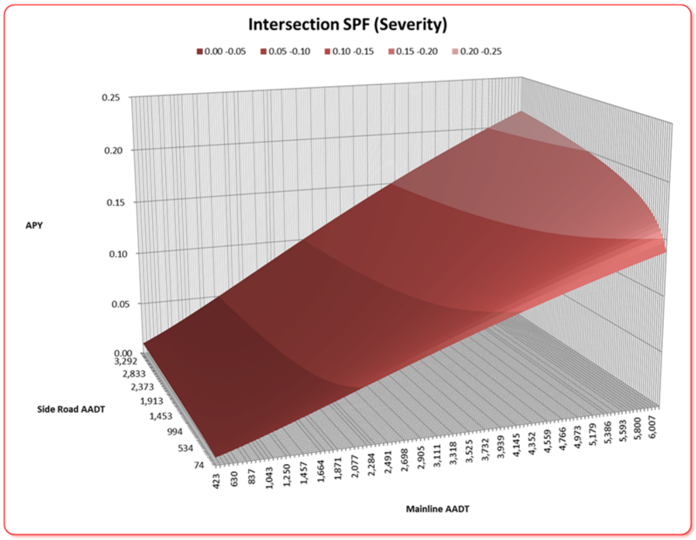
Montana - Rural 2-Lane Divided UnSignalized 3-Leg (R2XDU3)

$$APY_{Sigmoid} = \gamma\left(\beta_0 + \frac{\beta_1}{\left(1 + \beta_2\left(\frac{AADT_{Major}}{10{,}000}\right)^{-\beta_3}\right)\left(1 + \beta_4\left(\frac{AADT_{Minor}}{10{,}000}\right)^{-\beta_5}\right)}\right)$$

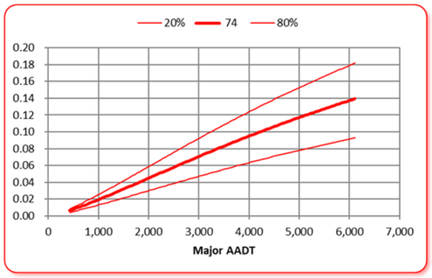
Intersection Safety Study – R2XDU3

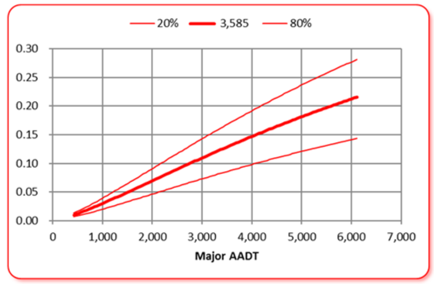


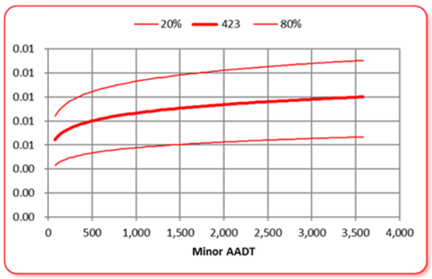
Intersection Safety Study – R2XDU3

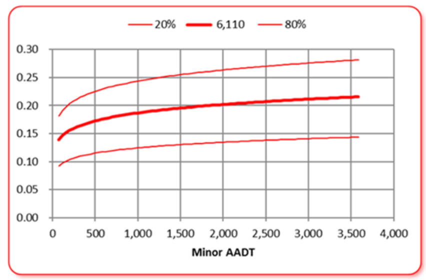


Intersection Model – R2XDU3 (Severity)



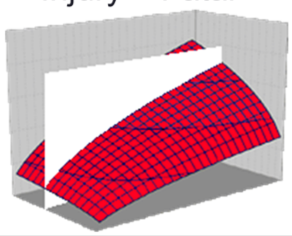




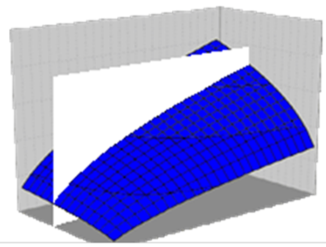


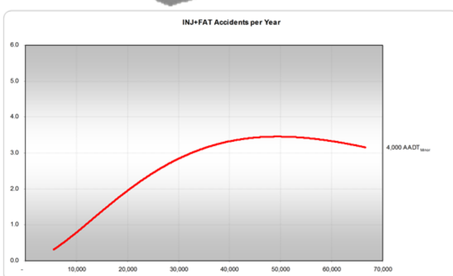
SPF Response Surfaces and Slice Graph

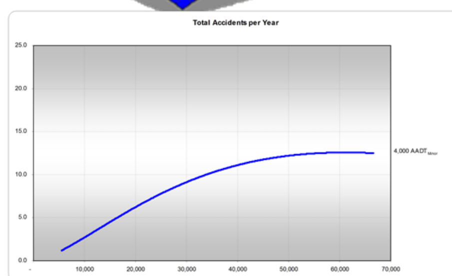
Injury + Fatal



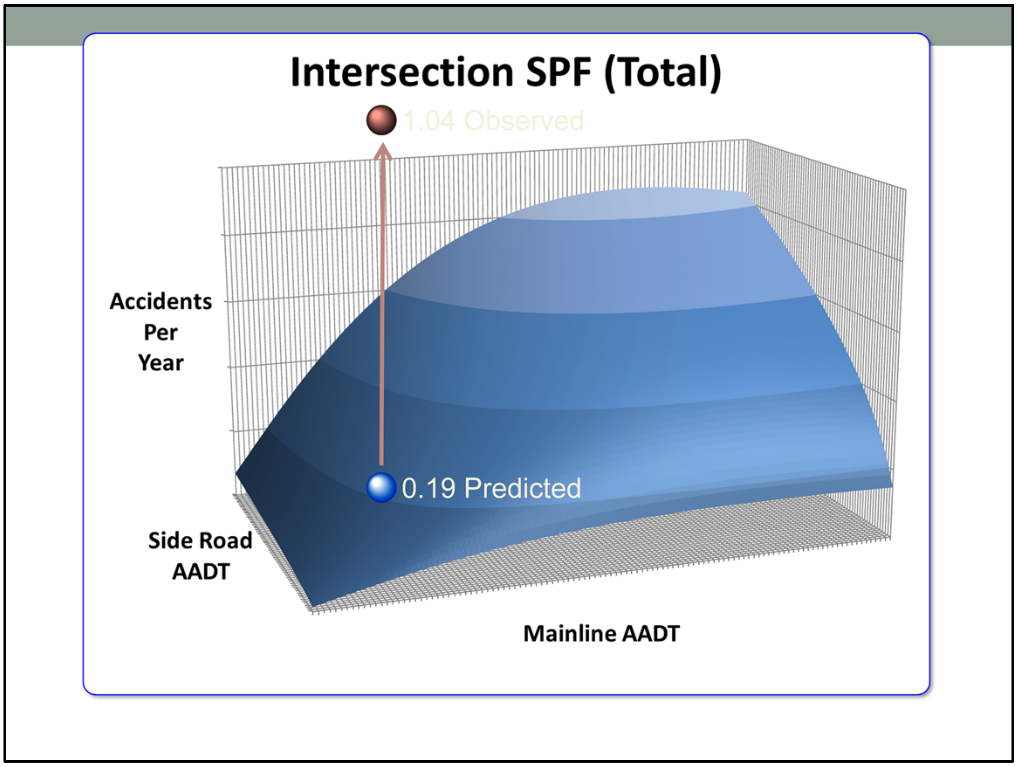
Total



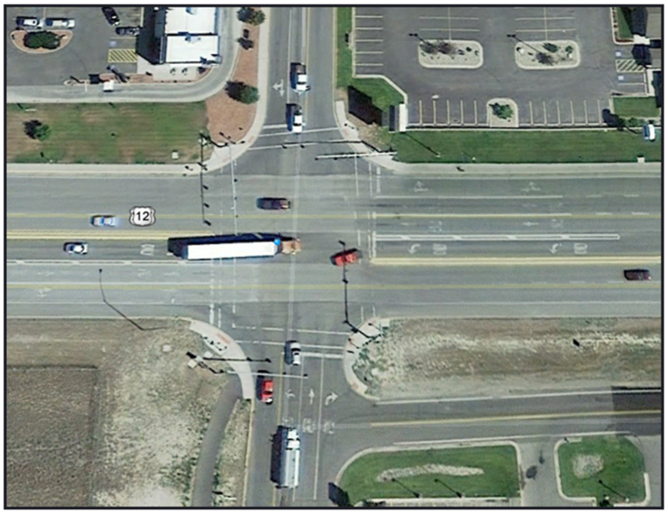




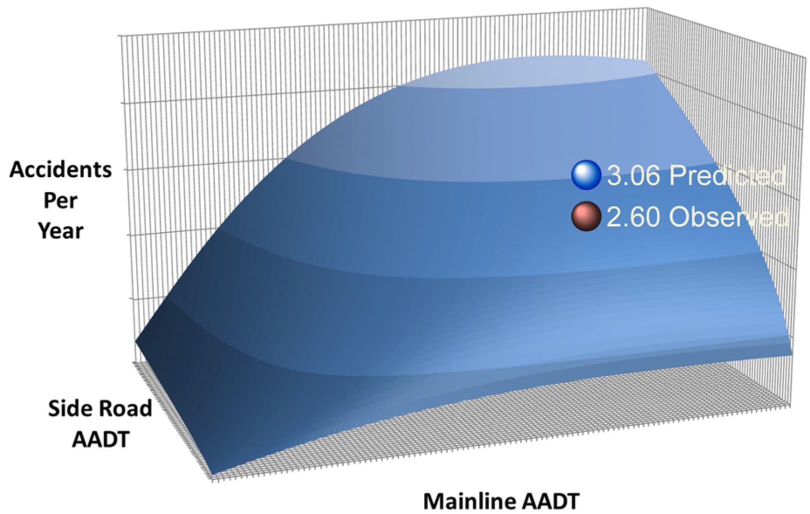
Site #1 Example


Intersection SPF (Total)
1.04 Observed
Accidents Per Year
0.19 Predicted
Side Road AADT
Mainline AADT

Site #2 Example



Intersection SPF (Total)



Intersection Model – U4XDU4

MONTANA

Montana Department of Transportation
DiExSys™ Roadway Safety Systems
Diagnostics Comparison Percentages Baselines

11/03/2016

Job #: 20161103160729

Highway Class: MT - Urban 4-Lane Divided UnSignalized 4-Leg Intersections - AADT All Totals (2016)

Baseline Statistics — **Statewide Average**

CATEGORY	# ACC's	%
Property Damage Only (PDO)	681	70.21%
Injury (INJ)	286	29.48%
Fatal (FAT)	3	0.31%
Persons Injured	427	
Persons Killed	3	
Single Vehicle Accidents	27	2.78%
Two Vehicle Accidents	862	88.87%
Three or More Vehicle Accidents	81	8.35%
Unknown Number of Vehicles	0	0.00%
On Road	960	98.97%
Off Road	9	0.93%
Off Road Left	1	0.10%
Off Road Right	8	0.82%
Off Road at Tee	0	0.00%
Off Road in Median	0	0.00%
Unknown Road Location	1	0.10%
Overturning	1	0.10%
Other Non Collision	0	0.00%
Vehicle Cargo or Debris	0	0.00%
Pedestrian	11	1.13%
Broadside	313	32.27%
Head On	7	0.72%
Rear End	380	39.18%
Sideswipe (Same Direction)	96	9.90%
Sideswipe (Opposite Direction)	8	0.82%
Approach Turn	75	7.73%

Baseline Statistics — **Statewide Average**

CATEGORY	# ACC's	%
Large Boulders or Rocks	0	0.00%
Rocks in Roadway	0	0.00%
Barricade	0	0.00%
Wall or Building	0	0.00%
Crash Cushion	0	0.00%
Mailbox	0	0.00%
Other Fixed Object	6	0.62%
Involving Other Object	1	0.10%
Road Maintenance Equipment	0	0.00%
Unknown Accident Type	9	0.93%
Total Fixed Objects	24	2.47%
Total Other Objects	1	0.10%
Daylight	795	81.96%
Dawn or Dusk	22	2.27%
Dark - Lighted	123	12.68%
Dark - Unlighted	28	2.89%
Unknown Lighting	2	0.21%
No Adverse Weather	837	86.29%
Rain	55	5.67%
Snow or Sleet or Hail	69	7.11%
Fog	4	0.41%
Dust	1	0.10%
Wind	3	0.31%
Unknown Weather	1	0.10%
Dry Road	706	72.78%
Wet Road	122	12.58%

Intersection Safety Plan

- Ten various intersection types have Montana specific SPF models developed

  1 – Rural 2 Lane Divided Unsignalized 3 Legs
  2 – Rural 2 Lane Divided Unsignalized 4 Legs
  3 – Rural 2 Lane Undivided Unsignalized 3 Legs
  4 – Rural 2 Lane Undivided Unsignalized 4 Legs
  5 – Urban 2 Lane Divided Signalized 4 Legs
  6 – Urban 2 Lane Divided Unsignalized 3 Legs
  7 – Urban 4 Lane Divided Signalized 3 Legs
  8 – Urban 4 Lane Divided Signalized 4 Legs
  9 – Urban 4 Lane Divided Unsignalized 3 Legs
  10 –Urban 4 Lane Divided Unsignalized 4 Legs

Future Plans

Future Plans for the HSIP

- Intersections
  - Begin to utilize the safety performance functions for the 10 intersections that have been developed.
    - 15 additional Montana Intersection Safety Performance Functions are forthcoming.

Future Plans for the HSIP / Safety

- Roadway Segments and Intersections
  - Continue to use the LOSS and SPF concepts in:
    - Development of future HSIP projects
    - Performing safety analyses for Department wide projects - where models available
- SIMS – Expand integration w/ MDT roadway elements
- Media Campaign – Roadway Departure
  - Summer 2015 – Present

Questions and Discussion

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